Contextual Inquiry: Discovering Physicians' True Needs

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Gathering user requirements that represent the true needs of the users is a challenge. There are many elicitation methods in use today, but they generally are not successful in identifying a comprehensive set of requirements that reflect the users' true needs. This paper describes the requirements gathering method, Contextual Inquiry, that we used to generate physician requirements for a comprehensive Clinical Information System. We feel that this method has advantages over traditional techniques such as surveys, questionnaires, traditional interviews, and focus groups, in obtaining a more comprehensive analysis of the true needs of the users.

BACKGROUND

Project Spectrum is a joint technology consortium consisting of Washington University School of Medicine, BJC Health System, IBM, Kodak, and SBC Corp. (formerly known as Southwestern Bell).[1] The purpose of Project Spectrum is to provide users with comprehensive, longitudinal clinical information across all 15 hospitals in the BJC Health System. The user interface team was specifically tasked with defining the physician requirements for Phase I of this project, which had been scoped as providing clinicians with the capability to view all readily available, clinically significant test results (e.g., radiology, laboratory, pathology) for their patients from the office, home, or hospital. The target user for Phase I is a clinical physician (not a resident, intern, or nurse) in the field of general medicine or general surgery. This includes both academic and community physicians.

Due to past experiences with introducing information systems into the BJC Health System for physicians, it was believed and emphasized at all management levels that the resulting Clinical Information System (CIS) must truly meet the needs of the physicians in a highly usable manner. To ensure that this would be the case, we knew we needed to start with, and focus on, the physicians. The approach we chose was Contextual Inquiry. Contextual Inquiry is a field research technique that is dependent on a two-way interaction between the user and the person performing Contextual Inquiry. The technique involves going to the field (the users' work environment) and interviewing and observing the physicians as they perform the work Project Spectrum is interested in supporting.[2,3,4]

CONTEXTUAL INQUIRY

The purpose of Contextual Inquiry is to understand the users' true needs by observing and interviewing them in the context of their work. Once their true needs and objectives are understood using Contextual Inquiry, work redesign and interface prototyping activities can begin to produce a CIS which allows users to adapt their current work process to take full advantage of new technology. This paper describes the first part of the process, Contextual Inquiry.

Contextual Inquiry (CI) involves going to the users' actual work environment and interviewing and observing the users while they perform the work you are interested in supporting. It is based on three key concepts: Context, Partnership, and Focus.

- Context is all the interrelated conditions that surround the user's work. It includes the user's physical environment, the people and places the user interacts with, cultural and organizational influences, and tools (both automated and manual) that the user utilizes. To accurately understand the users' needs, you must understand their work in the context of their "real world."
- Partnership is the relationship between the person performing CI and the user. If we simply ask users what they want (the traditional interview situation), the users will be unable to tell us accurately and completely. The users work at a higher abstraction level and cannot articulate the many elements of their work. However, if we passively observe users in their work environment (the workflow observation and shadowing technique), we run the risk of misinterpreting the users' actions. So, we employ users as co-investigators to accurately and completely identify their needs.
- Focus is the scope of the area of concern. The purpose of a focus is to facilitate the gathering of

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complete, detailed information in the area of interest.

USING CONTEXTUAL INQUIRY TO DETERMINE PHYSICIAN WORKSTATION REQUIREMENTS

The BJC Health System is made up of approximately 15 hospitals ranging from small rural hospitals to large tertiary hospitals. For phase I of Project Spectrum, six hospitals were chosen as the initial deployment sites. We formed a team of 10 general medicine and general surgery physicians representing these six hospitals and Washington University School of Medicine. We selected physicians that were open to change and new ideas, who had the willingness to work with us over time, and who fit the profile of our phase I user. We did not focus on physicians who already had computer experience. We ended up with a good mix of physicians who used computers, physicians who had computers but did not use them, and physicians who did not even own computers. A physician on our user interface team made the contacts with the candidates. The resulting make-up of the team met most of our criteria, although we did end up with a few physicians with sub-specialties. We felt that their presence would actually help us since we need to be open to the needs of specialists in the future and these physicians also perform general medicine or general surgery tasks in the course of practicing their sub-specialty.

Our overall process began with CI sessions in the office and then inpatient settings. After each session, we analyzed the information. At two points during the process, halfway through the sessions and after the sessions were complete, we consolidated the information across physicians. We generated the requirements from this consolidated information, and then the physicians prioritized the requirements independently.

Beginning in August, 1994, we estimate that we have spent approximately 300 hours executing CI sessions which includes 80 physician hours in direct participation, 130 staff hours in direct participation, and 90 staff hours in post-session documentation. An additional 1300 staff hours have been spent in data analysis sessions over a three-month time-frame.

The Contextual Inquiry Session

The CI sessions involved one member of the user interface team interviewing the physician in his work environment while he was performing the tasks in our focus. All physicians on our team were male, so references to them in this paper are in terms of the male gender. A typical session had three stages:

- Orientation (approximately 10 to 15 minutes) which included restating the purpose for the session, a reminder of the process for the interview, introductions to people we would meet during the session, and a tour of the facility if applicable (typically done in the office setting). We also had the participant sign a consent form so we could audio tape the sessions and collect artifacts.
- Interview (ranged from 1 to 6 hours) which involved the physician performing clinical tasks exactly the way he normally would, except that he would describe what he was doing as he performed the tasks and we interjected questions to obtain more detailed information. The office setting interviews took between 4 to 6 hours because it was important to view the physicians before office visits as they processed clinical information coming in the mail, through their office visits as they processed clinical information relevant to those patients, and then sometimes after office visits as they performed additional clinical tasks. The inpatient setting interviews tended to be 1 to 2 hours depending on the number of patients the physician currently had in the hospital, and the number of hospitals he had to visit.
- Wrap-up (approximately 5 minutes) which usually involved a verbal thank-you and a description of the follow-up material we would provide.

During the last half of the CI sessions, we brought in members of other Project Spectrum teams as observers. The Project Spectrum team members attended a CI session and were asked to actively participate in the analysis of that session. The observers felt that they benefited from the experience and we felt that the project benefited as a whole. The team members' experiences provided them with an overall understanding of the true context of the user which helped them to understand how various project tasks fit together. It also helped team members understand medical terms and issues they had heard within the project but with which they were not familiar.

ANALYZING / INTERPRETING THE DATA

Following each CI session, the data obtained were analyzed. The analysis effort produced a *Sequence Model*, *Flow Model*, *Context Model*, detailed *Observations*, and *User Profile* for each CI session.

- The *Sequence Model* documented the sequences of activities the physician performed, what triggered the sequences to occur, and the physician's intent at the time the sequences were performed.

This model helped to identify common work flows across physicians and was ultimately used to generate the context of use sections for the requirements document.

- The *Flow Model* documented the information and items flowing between the physician and other people or places. This model identified information flow bottlenecks, as well as heavy and light information flow areas. See Figure 1.
- The *Context Model* documented external influences which affected how the physician cared for patients. To create a physician's workstation that truly meets the user's needs, these influences must be taken into account.
- The *Observations* were the primary source for the requirements. The Observations contained the details of what the physician did, details of the information the physician reviewed, any design ideas the physician mentioned, questions and comments the physician had, and questions we had that needed to be resolved by the physician.
- The *User Profile* was simply a description of the user's characteristics.

A CI session was performed with each physician in the office setting and the inpatient setting. We noticed after several CI sessions in the office and inpatient settings that we were not getting much, if any, additional information. However, since the physicians were representing different hospitals, we continued with the remaining CI sessions to make sure there were no hidden differences based on hospital influence. We also wanted to ensure that all physicians were equally involved and all hospitals were equally represented.

The Consolidation of Physician Analysis Data

After analyzing the information from the individual CI sessions, we consolidated this information across physicians. We did this at the halfway mark and again at the completion of the CI sessions. In both consolidation sessions, we created a Flow Model which consolidated the flow of information and items across physicians, and a Context Model which consolidated the influences across physicians. We then took the Observations and created an affinity diagram (a logical grouping of the observations in a tree structure) with them.

Physician Requirements Session

After completion of the CI sessions and their analysis, we met with the physicians to give them the opportunity to voice any additional concerns, issues, or requirements. The meetings generated a lot of discussion, but no new requirements within our focus.

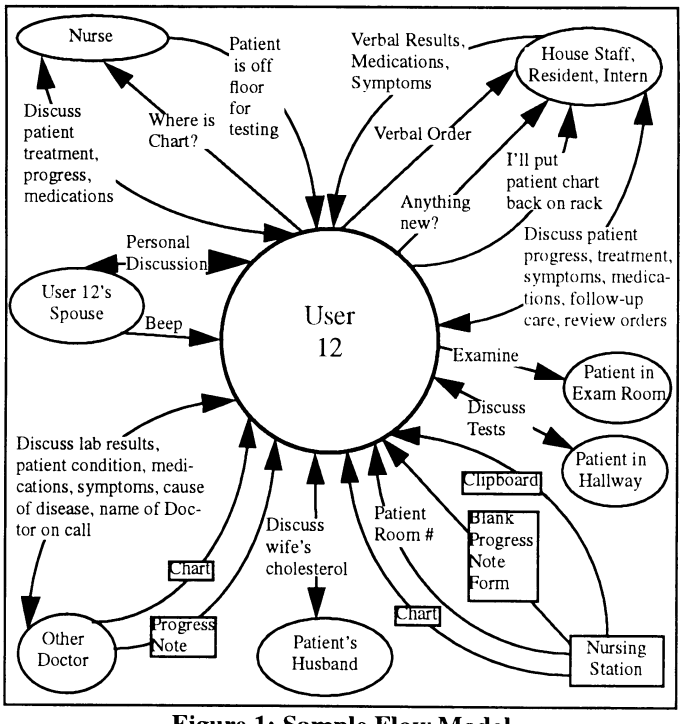

Figure 1: Sample Flow Model

The Requirements Generation and Rating Process

The requirements were generated using the affinity diagram of the Observations as the basis. Due to the number of requirements we generated, we created an affinity diagram of the requirements. At this stage we heavily involved a physician on our user interface team so that the resulting organization of the requirements would be clinically-focused. This then became the organization of the requirements document.

We took the requirements, added a rating scale to each requirement, and gave them to the physicians to review independently. The rating scale was from 1 to 10, with 10 being the highest rating. We took the ratings from all 10 physicians, averaged them, and calculated the standard deviations (which are included as part of the resulting requirements document).

The deliverable of our requirements generation task was a "requirements document." Our dilemma was how to convey all the information we collected about the physician, his needs, and his environment in a traditional "requirements document." What we had, in the form of requirements, were high-level requirements supported by detailed requirements. To support each detailed requirement, we generated context of use scenarios for both the office and inpatient settings based on the Sequence Models and Observations. We

3.1.9.10 The user must be able to review ECGs. (Mean: 9.00, Standard Deviation: 0.94)

Context of Use

The users' necessity to be able to review ECGs is illustrated in the following contexts in an *office* setting:

- The physician is in his office, sitting at his desk, processing his mail. The mail has been categorized for him (e.g., results vs. junk mail). He accesses the next mail item and it is an ECG. He reviews it by reading the remarks section and the cardiologist's name. The text says it's unchanged, so he doesn't review the signal. He indicates that he's seen it and sends it to his partner for review.
- <additional context of use scenarios omitted>

The users' necessity to be able to review ECGs is illustrated in the following contexts in an *inpatient* setting:

- The physician goes to the nursing station in the hospital at 9:00 a.m. and accesses the new patient's chart. He looks for the medications and vital signs, but nothing is available yet. He reads the current physician orders and the Emergency Department report. He then looks at the ECG reviewing the tracings only (he likes to review his own ECGs). He looks at the physicians' notes and signs the admission note. He reviews laboratory results and vital signs. He then enters the patient's room to examine the patient.

Detailed Requirements

3.1.9.10.1 The user must be able to locate/specify desired ECGs that are needed for comparison. (Mean: 9.20, Standard Deviation: 0.87)

<requirements omitted>

3.1.9.10.9 The user must have the facilities available to calculate rate, PR interval, etc. (Mean: 7.90, Standard Deviation: 2.30)

3.1.9.0.10 The user must be easily able to review the ECG findings and the cardiologist's name without having to view the tracings (Mean: 7.50, Standard Deviation: 2.42)

Figure 2: Sample Physician Requirement

did this to illustrate the true meaning of the requirements and the context in which the requirements became evident. The context of use scenarios are currently being used to exercise the development architecture. See Figure 2 for a sample requirement.

RESULTS / REFLECTIONS

The key findings from our CI effort were:

1. The physicians need one-stop shopping of timely, comprehensive, and effectively organized presentation of clinical information.
2. The physicians need to do more than merely examine and review clinical information. They actively summarize, abstract, manipulate, and annotate results in order to process them effectively. This finding, although not expected at the start of the CI sessions, was heard repeatedly in the CI sessions.
3. The physicians have complex and wide-ranging communication needs which are heavily intertwined with their results review needs. We anticipated the complex communication needs, but the extent to which their communication needs and clinical activities were intertwined was not expected.
4. Although the physicians have a general sense that a CIS should increase their productivity, they also have a significant level of concern that the CIS could become a barrier between them and the clinical information.

We generated 542 requirements using CI. Of the 542 requirements, 411 had a mean physician rating greater than or equal to 8 (an 8 to 10 rating meant "This requirement must be met in the workstation before I'll use it.") Although the ratings were generally high (as would be expected since the requirements were generated directly from the physician CI sessions), we were pleased to see some variance in the ratings and meaningful comments scattered throughout the documents the physicians used to rate the requirements (even after page 90 in a 100-page document). It was also interesting to note that only two of the 542 requirements received a perfect 10 physician rating. The two requirements were:

- The user must be able to sign on to the system easily
- The user must be able to review radiology reports.

We interpreted the first requirement as more than a need to sign onto the system easily, but a need for the entire workstation to be usable. The second requirement reflects the frustration the physicians currently have finding radiology images. The physicians currently waste so much time finding radiology images, that they rely heavily on the radiology reports.

A major benefit of using CI was the resulting relationship with the physicians. We expected this to a degree, but were amazed at the enthusiasm of the physicians regarding Project Spectrum and the process.

The physicians feel like they are part of Project Spectrum and believe that the project is really being driven by their needs. This is mostly due to the fact that with CI, we spent an extended amount of time with each physician in a one-on-one setting actively inquiring about their needs, wishes, and problems.

NEXT STEPS

We currently are performing a detailed scoping of exactly what tasks the physicians will be able to perform with phase I of the CIS. We are using the requirements and the physicians' ratings as the basis for this, factoring in data availability and the impact on other teams within Project Spectrum. Once the scoping for phase I is complete, we will begin the design and prototyping effort, followed by the full CIS development. In addition, we are taking steps to address each of the key findings discovered during the CI process.

DISCUSSION

During our planning stages for the enterprise-wide CIS, we examined various requirements-gathering methods, both methods we had used in the past and new ones being used in industry.

We found surveys and questionnaires to be too limited in scope to be our sole method. Although they have the benefit of a large sample size, the results are limited to the questions specifically addressed. The traditional interview can be used to gather facts and opinions, as well as to identify broad areas to explore in more depth. However, the results are again limited to the questions or topics addressed in the interview. Also, the results tend to be abstract and general because users are unable to articulate the many details of their work. The focus group is limited because people generally cannot verbalize their needs when they are not actually in the context of their work and their work environment. The results are often not complete, and sometimes not even accurate. An excellent facilitator can minimize these problems, but the limitations will still be there to a degree.

Previous work in the medical environment demonstrates the use of combinations of these methods, as well as the addition of techniques such as shadowing and workflow or process flow observations[5,6] to produce a better understanding of diverse user needs. However, other investigators state that the primary source of requirements was obtained using physician meetings, an out-of-context requirements-gathering approach.[6]

Using CI, we feel we were able to gather accurate and comprehensive information about the physicians' needs for effectively and efficiently caring for their patients. Taking into account not only the requirements we generated using CI, but also the current information flow and contextual influences on the physician, we will be able to provide them with a system that not only meets their clinical information processing needs, but fits into the context of how they care for patients. This will allow them to adapt from their current process to take advantage of the new technology Project Spectrum will provide.

The success of this project depends on whether or not the physicians find that they can use this system to more efficiently or effectively care for their patients. To ensure success, we began with a strong focus on the users. We plan to continue this focus throughout Project Spectrum to ensure that the resulting system is usable, preferable, and truly meets their needs.

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